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Assignment 10

Topic 'Crossover'

Problem 1 Consider some evolutionary algorithm using uniform crossover on OneMax. Consider an arbitrary search point $x \in \{0,1\}^n$. Compute $\max_{y \in \{0,1\}^n} \mathrm{E}\left(\textsc{OneMax}\left(\text{crossover}(x,y)\right)\right)$.

Topic 'Selection'

Problem 2 We consider the (1, λ) EA as defined below using the usual mutation probability $1/n$.

1. Choose $x \in \{0,1\}^n$ uniformly at random.
2. Repeat
3. For $i \in \{1, 2, \ldots, \lambda\}$
4. Generate y_i by standard bit mutation of x.
5. Replace x by some y_i with $f(y_i) = \max\{f(y_1), f(y_2), \ldots, f(y_\lambda)\}$.
6. Until 'decide to stop'.
7. Output x.

Prove an upper bound for the expected number of function evaluations the (1, n) EA (i. e., the (1, λ) EA with $\lambda = n$) makes before finding the global optimum of the function LeadingOnes.

Problem 3 <u>**Implementation Task**</u>

Consider the objective function $f(x) := \begin{cases} \sum_{i=1}^{n} x[i] & \text{if } \sum_{i=1}^{n} x[i] < \lfloor 2n/3 \rfloor, \\ \left(\sum_{i=1}^{n} x[i]\right) - \lfloor \sqrt{n} \rfloor & \text{otherwise.} \end{cases}$

Add the implementation of the (1, $\lfloor \log_2 n \rfloor$) EA (i. e., the (1, λ) EA with $\lambda = \lfloor \log_2 n \rfloor$) to your implementation of randomised search heuristics. Compare this algorithm with the (1+1) EA on f. Perform 30 runs and compare the optimisation times for $n \in \{10, 20, 30, 40, 50\}$. Can you explain the performance difference?

Assignments are handed out on each Friday during the lecture. Written solutions are due the next Wednesday. Feedback is given and solutions are discussed the Wednesday after that.